REMARKS

Claims in the Application. In the instant amendment, Claims 90, 93, 102, 111, 126, 132, 134-136, 138, 160-162, 164-167, 171, 173, 175, 179, 181-189, 191 and 194-195 have been cancelled from this application. Claims 77, 92, 94, 96-97, 99-100, 107, 109, 110, 114, 119, 123, 129, 131, 137, 139, 141, 143-144, 146, 158-159, 172, 176-177, 180 and 196 have been amended. Claims 197-226 have been added to this application.

Accordingly, Claims 77-81, 83-89, 92, 94, 96-97, 99-100, 104, 106, 107, 109-110, 114, 119, 122-124, 129-131, 137, 139-159, 163, 168-170, 172, 174, 176-178, 180, 190, 192-193 and 196-226 are active in this application. The active claims of the application may be grouped as follows:

Independent Claim	Dependent Claims
77	78-81, 122, 83—89, 198, 99, 225
159	94, 106, 97, 100, 124, 107, 205, 109-110, 119, 131, 137, 174, 197, 92, 202-204, 206
163	158, 200, 207-216, 226
168	129, 130, 217, 218
169	96, 172, 114, 123, 139-157, 180, 190, 199
170	104, 176-178, 192-193, 196, 219-221
201	222-224

Interview of April 21, 2008. Applicants' attorney wishes to thank Examiner Toomer for the very helpful and courteous interview which was extended on April 21, 2008. The attendees at this interview were the Examiner, the undersigned and Jeff Jones, Construction Manager/Process Engineer for NOVA Biosource America, Inc., the assignee of record. Each of the independent claims – Claims 77, 159, 163, 168, 169, 170 and 201 – was discussed.

Applicants initiated the interview by discussing the specifications of biodiesel, ASTM D-6751-02 (p. 22, l. 9). A copy of ASTM D-6751-02 is attached hereto. The procedures set forth in the cited prior art - U.S. Patent No. 2,383,580 ("*Arrowsmith*") and U.S. Patent No. 2,588,435 ("*van Loon*") - render unacceptable levels of water, glycerol and glycerides to be suitable as biodiesel.

Applicants proposed amendment of Claims 77 and 159 to recite separation of the transesterified stream into a fatty acid alkyl ester rich stream and a glycerin rich stream and then subsequently purifying the fatty acid alkyl ester rich stream. In addition, it was proposed to

further amend Claims 77 and 159 to recite some of the ASTM specifications for biodiesel. Applicants further discussed amending Claim 170 to recite conditioning of the feedstock to render a heterogeneous feedstock mixture of uniform viscosity. The proposed amendments to the claims have been made herein.

Exemplary support for these amendments made be found at page 17, ll. 16-20 (separation of a fatty acid alkyl ester rich stream and a glycerin rich stream from a liquid stream prior to purifying the fatty acid alkyl ester rich stream by distillation or fractionation to produce biodiesel); and p. 28, ll. 14-19 (conditioning the feedstock containing free fatty acids to render a heterogeneous feedstock mixture of uniform viscosity and then reacting the conditioned feedstock with glycerin to render glycerides).

It was further argued that no amendments to Claims 163, 168 and 169 were necessary since Claim 163 recited separation of the fatty acid alkyl ester rich stream into three fractions – a bottoms fraction, an overhead fraction and a side stream fraction; Claim 168 recited purification of a glycerin rich stream subsequent to separation of a fatty acid alkyl ester stream from the glycerin rich stream; and Claim 169 recited adjustment of the pH of the glycerin rich stream subsequent to separation of the glyceride/alcohol reaction stream into a fatty acid alkyl ester rich stream and a glycerin rich stream.

Applicants further discussed the addition of Claim 201 which recited the removal of alcohol from the fatty acid alkyl rich stream, subsequent to purification of the fatty acid rich stream from the glycerin rich stream, and along with purification of the fatty acid alkyl rich stream by distillation or fractionation. *See*; for instance, p. 29, ll. 14-17.

The Examiner indicated that Claims 163, 168 and 169 were distinguishable over the cited prior art. The Examiner further indicated that the proposed amendments to Claims 77, 159 and 170 would appear to overcome the cited prior art.

Examiner's Rejection of the Claims. The Examiner has rejected the claims as follows:

(a) Claims 132 and 134-196 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Arrowsmith*; and

(b) Claims 77-81, 83-90, 92-94, 96-97, 99-100, 102, 104, 106-107, 109-111, 114, 119, 122-124, 126, 129-131 and 134-137 under 35 U.S.C. § 103(a) as being unpatentable over *van Loon* in view of *Arrowsmith*.

These grounds of rejection are traversed.

The claims of Applicants are directed to a method of making purified biodiesel. Biodiesel is a fuel comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats, designated B100. Biodiesel is typically produced by reaction of a vegetable oil or animal fat with an alcohol, such as methanol or ethanol, in the presence of a catalyst to yield mono-alkyl esters and glycerin. The glycerin is then removed.

Biodiesel, as defined in D 6751-2, is registered with the US EPA as a fuel and a fuel additive under Section 211(b) of the Clean Air Act. ASTM D 6751-2 sets forth the requisite standards for acid number and total glycerin for biodiesel:

> Section X1.10 Acid Number. ASTM D 6751 recognizes that "biodiesel with a high acid number has been shown to increase fueling system deposits and may increase the likelihood for corrosion." Table I of this section shows a limit of 0.80 max mg KOH/g; and
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> Section X1.12 Total Glycerin. ASTM D 6751 recognizes that "high levels of mono-, di-, and triglycerides can cause injector deposits and may adversely affect cold weather operation and filter plugging." Low levels of glycerin ensure a high conversion of oil or fat into fatty acid alkyl esters. The maximum total glycerin is 0.240 mass %.

Biodiesel can be used in any concentration with petroleum based diesel fuel in existing diesel engines. Engine manufacturing companies require that biodiesel used in engines must meet ASTM D-6751 as a condition of warranty. Other "bio-derived" materials that do not meet D-6751 may cause engine and fuel systems problems and void engine warranties.

Neither reference cited by the Examiner is directed to a method of producing biodiesel. Both *van Loon* and *Arrowsmith* disclose a method for preparing soaps. The resultant ester produced in *van Loon* and *Arrowsmith* would be tolerant of water, glycerol and glyceride levels. The levels of water, glycerol and glycerides resulting from soap making are not acceptable levels for biodiesel. As such, neither *Van Loon* nor *Arrowsmith* discloses a process that would be suitable for producing biodiesel.

Arrowsmith uses fatty oils which are "suitable for employment by the soapmaking art" (p. 2, col. 2, l. 11). Raw vegetable oil or feedstock for soap is not equivalent to biodiesel. The process disclosed in *Arrowsmith* requires the following steps:

(1) reaction of a glyceride with an alcohol in the presence of a catalyst;

(2) inhibition of the catalyst by neutralization, followed by removal of the unreacted alcohol;

(3) recovery of the alkyl esters and higher alcohols (such as glycerin) in "highly purified form" after removal of the alcohol; and

(4) distillation of the alkyl esters and glycerin into two layers.

(P. 2, col. 2, ll. 2-14.)

The process disclosed in each of the independent claims of Applicants is not disclosed in *Arrowsmith*:

Claim 77 discloses separation of the transesterified stream into a fatty acid alkyl ester rich stream and a glycerin rich stream and *then subsequently* purifying the fatty acid alkyl ester rich stream. The recovered product which contains the separated fatty acid alkyl esters can therefore function as biodiesel.

In contrast to Claim 77, the stream in *Arrowsmith* contains *both* an ester rich stream and a glycerin rich stream during distillation. *Arrowsmith* teaches neutralization of the transesterfication effluent "to form a mixture containing both free fatty acid and fatty acid soap" (p. 2, col. 1, l. 24). Co-distillation of the neutralized heavy and light phases results in a two-phase distillate comprising primarily esters and glycerin. An ester/glycerol azeotrope may even be formed (p. 2, col. 1, l. 57). Due to the appreciable solubility of glycerol in esters, such co-distilled esters, even after gravimetric separation, fail to meet the claimed total glycerin content of Applicants. *Arrowsmith* teaches the ester distillate as containing "partially reacted glycerides if present" (p. 2, col. 2, l. 74). Thus, the method taught by *Arrowsmith* does not intentionally limit the amount of glycerides that distill along with the esters. The disclosed method therefore cannot reliably produce a total glycerin of 0.240% mass or less. The failure of *Arrowsmith* to disclose the claimed limitations is even more accented in those instances where the co-distillate contains a condensed azeotrope. (*Arrowsmith* discloses one exception to co-distillation in p. 2, col. 1, l. 49 wherein the potential for separation of co-neutralized heavy and light phases prior to distillation of the ester phase is discussed. Even here however *Arrowsmith* does not teach minimization of glycerin or glycerides to meet the glycerin requirements of the ASTM specification, as set forth in amended Claims 77 and 159.)

Nor does *Arrowsmith* quantify the minimum acid number reflected in amended Claims 77 and 159. The mixed distillation of *Arrowsmith* is unable to adequately minimize the free fatty acids in the ester layer, especially as low as 0.80 mg KOH/g.

Claim 159, like Claim 77, require separation prior to purification. Claim 159 recites separating a fatty acid alkyl ester rich stream and the glycerin rich stream from the liquid stream obtained from the reaction of glycerides and alcohol. Such separation occurs *prior to* purification of the fatty acid alkyl ester rich stream. Further, see the discussion above in respect to the claimed acid number and total glycerin limitations of the produced biodiesel;

Claim 163 of Applicants recites separation of the fatty acid alkyl ester rich stream into three fractions – a bottoms fraction, an overhead fraction and a side stream fraction. In addition to failing to disclose separation into a fatty acid alkyl ester rich stream prior to distillation, the references further fail to disclose separation of such a fatty acid alkyl ester rich stream into three fractions prior to recovery of biodiesel;

Claim 168 recites purification of a glycerin rich stream subsequent to separation of a fatty acid alkyl ester stream from the glycerin rich stream which renders glycerin purity greater than or equal to 95 percent, with non-detectable levels of methanol and salts (p. 13, ll. 6-9; p. 60, l. 2). No such separation is disclosed in either *van Loon* or *Arrowsmith*;

Claim 169 recites adjustment of the pH of the glycerin rich stream subsequent to separation of the glyceride/alcohol reaction stream into a fatty acid alkyl ester rich stream and a glycerin rich stream. In *Arrowsmith*, the catalyst is neutralized *prior to* removal of the unreacted alcohol and *prior to* separation of the alkyl ester rich stream from the glycerin rich stream. As a result, in *Arrowsmith* soaps revert in part to free fatty acids. As a result, free fatty acids are distilled with the esters resulting in Acid Number above the ASTM specification;

Claim 170 recites conditioning of the feedstock prior to reacting the feedstock with glycerin to produce the glycerides. No such conditioning is recited in either of the cited references; and

Claim 201 recites the removal of alcohol from the fatty acid alkyl rich stream prior to purification of the fatty acid alkyl rich stream by distillation or fractionation. In *Arrowsmith*, the alcohol, i.e., the "unreacted alcohol", is removed *prior to* separation of the fatty acid alkyl esters from the glycerin.

Van Loon discloses a process of producing esters (col. 1, l. 14) used as white or light-colored soaps. The process of *van Loon* consists of:

(1) converting "substantially all of the free fatty acid" in a feedstock to an ester which is "substantially free from water"; and

(2) reacting the esterified product with an alcohol to render a "low molecular weight monohydric alcohol esters of fatty acids." (Col. 1, ll. 23-50.

The mixture obtained "consists of residual glycerides, ethyl esters and some soap." (Col. 3, ll. 33-38.)

Van Loon does not disclose the claimed limitations of Applicants. For instance, *van Loon* does not disclose:

separation of the transesterified stream into a fatty acid alkyl ester rich stream and a glycerin rich stream and *then subsequently* purifying the fatty acid alkyl ester rich stream (Claim 77 of Applicants). The only teaching in *van Loon* of ester distillation is directed to the use of steam (col. 4, l. 52), which process causes esters to hydrolyze, and would produce a distillate leading to Acid Number in excess of 0.80 mg KOH/g, as claimed by Applicants. Further, *van Loon* does not teach such steam-driven distillation of the aforementioned mixture, which mixture consists of "residual glycerides, ethyl esters and some soaps", to result in a total glycerin equal to or below the claimed 0.240% mass;

separation of a fatty acid alkyl ester rich stream into three fractions – a bottoms fraction, an overhead fraction and a side stream fraction (Claim 163 of Applicants);

purification of a glycerin rich stream subsequent to separation of a fatty acid alkyl ester stream from the glycerin rich stream (Claim 168 of Applicants);

adjustment of the pH of the glycerin rich stream subsequent to separation of the glyceride/alcohol reaction stream into a fatty acid alkyl ester rich stream and a glycerin rich stream (Claim 169 of Applicants). *Van Loon* re-uses glycerin which is recovered from the transesterification in the esterification reaction and fails to teach adjustment of the pH of the glycerin to neutral prior to doing so. Failure to adjust the pH, as taught in *van Loon*, typically results in acidity of esters above ASTM standards;

conditioning of the feedstock prior to reacting the feedstock with glycerin to produce the glycerides (Claim 170 of Applicants); and

removal of alcohol from the fatty acid alkyl rich stream prior to purification of the fatty acid alkyl rich stream by distillation or fractionation (Claim 201 of Applicants).

In summary, neither *Arrowsmith* nor *van Loon* discloses the elements of the process claimed by Applicant, by themselves or in combination with each other. Reconsideration of the rejections is therefore respectfully requested.

The Examiner is respectfully requested to telephone the undersigned should she deem it prudent to expedite the prosecution of this matter and an issuance of a Notice of Allowance.

Respectfully submitted,

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